REMARKS

Claims 1-27 are now pending in the application. Minor amendments have been made to the specification to simply overcome the objections to the specification and rejections of the claims under 35 U.S.C. §112. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

DRAWINGS

Applicant has amended FIG. 7A to include reference number 153 to identify central portions between slits 150 and 152. Applicant has added windings 124 and insulation material 177 to FIG. 2A. Applicant has added FIG. 7C to illustrate the deformed central portions 153. No new matter has been entered by either of the changes as the central portions were described in Paragraph [0054] of the application and the insulation material is described in Paragraph [0059].

FIG. 11A has been amended to identify the stator plates 126 that form a stack in the stator segment core 120 as described in Paragraph [0054]. No new matter has been entered by these amendments.

DOUBLE PATENTING

Applicant respectfully submits that the rejection of claims 1-21 under the judicially created doctrine of double patenting in not ripe. None of the claims of either application (Serial Nos. 09/803,876 or 09/817,559) have been patented. When this issue becomes ripe, Applicant may consider filing a terminal disclaimer.

REJECTION UNDER 35 U.S.C. § 112

Applicants traverse the rejection of Claims 4, 5 and 10 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point and distinctly claim the subject matter which Applicant regards as the invention.

Regarding Claim 4, skilled artisans would know that slope is calculated by sampling the current as a function of time and fitting a line to the samples. For example, the current value is 4, 5, 6, 7, 7, 6, 5, and 4 for time values 1, 2, 3, 4, 5, 6, 7, and 8. The slope for the time interval [1, 2] is equal to (5-4)/(2-1) = +1. The slope for the next time intervals is +1, +1, 0, -1, -1, and -1. As set forth in the specification, "[b]y monitoring the slope of the current as it transitions from a positive value to zero to a negative value, the position of the rotor pole can be identified." Specification Paragraph [0047].

Regarding Claim 5, the current increases to a maximum when the leading edge of the rotor tooth is aligned with the trailing edge of the stator pole. Specification Paragraph [0047]. The inductance of the phase coil is at a maximum when the rotor is aligned with the stator as can be seen in FIG. 3B. Skilled artisans know that a lookup table stores data in tabular form. As set forth in the specification in Paragraph [0038], tables are stored in the lookup table. The sensorless drive circuit senses phase flux linkage and current at a predefined angle. The table stores possible current and flux linkage values. The drive circuit uses the measured values and the values from the table to calculate the deviation of the rotor from the predicted position. A similar system is described in the Background in Paragraph [0009].

Regarding Claim 10, in the specification in paragraph [0038], Applicants described the central portion and how the central portions releasably interconnect the stator plates of the stator core:

> The stator plates 126 are die cut from thin sheets of magnetically conductive material. During the die cutting operation, a first pair of slits 150 are cut into the outer rim section 120 and a second pair of slits 152 are cut into the pole section 130 and central portions between the slits are deformed. The slits 150 are transverse in alignment relative to the slits 152. The stator plates 126 that form the stator segment core 120 are stacked and press fit. This operation results in the stator plates 126 being releasably interconnected to define the stator segment core 120.

When the die punch impacts the central portions 153 (for example on an outer stator plate 126) between the slits 150 and 152, all of the central portions 153 deform from a planar shape into an non-planar or arc shape now shown in FIG. 7C. The deformed central portion 153 between one pair of slits 150 of the bottom stator plate 126 is received between the slits 150 of a second adjacent stator plate 126 in the stack. The deformed central portion 153 between one pair of slits 150 of the second stator plate 126 is received between the slits 150 of a third adjacent stator plate 126 in the stack. This interlocking arrangement continues for the remaining stator plates in the stack.

In addition, the deformed central portion 153 between one pair of slits 152 of a first or bottom stator plate 126 is received between the slits 152 of a second adjacent stator plate 126 in the stack. The deformed central portion 153 between one pair of slits 152 of the second stator plate 126 is received between the slits 152 of a third adjacent stator plate 126 in the stack. This interlocking arrangement continues for the remaining stator plates in the stack.

The slits 150 and 152 are transverse in alignment. Therefore, deformed central portions provide support in two directions.

Applicants believe that the rejection under § 112 is not moot.

REJECTION UNDER 35 U.S.C. § 103

Applicants traverse the rejection of Claims 1, 2, 6-8, 11, 12, 16-18, 21-23, and 26 under 35 U.S.C. § 103(a) as being unpatentable over Tang (U.S. Pat. No. 5,811,905) in view of Takeuchi et al. (U.S. Pat. No. 5,583,387).

Regarding Claims 1, 11 and 21, Tang does not show, teach or suggest a stator including a plurality of circumferentially-segmented stator segment assemblies. Takeuchi et al does not show, teach or suggest a switched reluctance electric machine wherein the rotor tends to rotate relative to the stator to maximize the inductance of an energized winding.

Tang shows a switched reluctance machine with a stator core. The Examiner admits that there is no teaching or suggestion in Tang for segmenting the stator of the switched reluctance machine.

Takeuchi et al. teaches a segmented stator but does not disclose a switched reluctance electric machine.

In making the combination, the Examiner asserts that the combination would be made "for the purpose of increasing efficiency of a motor." In particular, Takeuchi et al. employs a segmented stator to increase slot fill from 52-55% to 70%. Col. 1, lines 19-25, and Col. 3, lines 43-45.

The facts in this case are contrary to the Examiner's assertion that it would be obvious to combine the references. Despite the existence of the two separate

teachings for over 50 years (as described below), no one has made the combination. If the combination is obvious, then why has it not been done?

For over 160 years, machine designers have employed a non-segmented stator in switched reluctance machines. One of the earliest recorded switched reluctance motors was built by Davidson in Scotland in 1838. "Switched Reluctance Motors and their Control", T. J. E. Miller (Magna Physics Publishing 1993), p. 5 (attached hereto).

Non-segmented stators in switched reluctance machines continued to be used for over 50 years <u>after</u> the use of segmented stators in other types of electric machines. Sheldon (U.S. Patent No. 2,688,103, which was issued in 1952) teaches a segmented stator for an electric machine to improve the efficiency of the electric machine (Col. 1, lines 17-24), but does not disclose the use of the segmented stator in a switched reluctance machine.

Neither the Examiner nor Applicants are able to identify any examples of switched reluctance machines with a segmented stator. This may be due to one of the key advantages of switched reluctance motors ~ simple construction. In the Introduction of "Switched Reluctance Motors and their Control", Miller states:

> The geometry [of the switched reluctance motor] is beguilingly simple, and everything about the motor and its control seems at first sight to be a gift to the production engineer. Yet the attainment of good designs and satisfactory performance is practically impossible by traditional design methods.

See Introduction attached hereto. Segmenting the stator clearly increases the complexity of the design, which is counter to one of the primary reasons for using switched reluctance machines in the first place.

Based on the foregoing, it is clear that the conventional wisdom is to use non-segmented stators when designing switched reluctance machines. Proceeding against the conventional wisdom is evidence of nonobviousness. Arkie Lures Inc. v. Gene Larew Tackle, Inc., 43 USPQ2d 1294, 1297 (Fed.Cir. 1997); In re Hedges, 783 F.2d 1038, 1041, 228 USPQ 685, 687 (Fed. Cir. 1986). Here, Applicants have made the construction of the switched reluctance motor more complex by segmenting the stator. The geometry is no longer "beguilingly simple".

While improved slot fill is achieved by segmenting the stator, the primary motivation for segmenting the stator was to improve manufacturing tolerances and the electrical characteristics of the switched reluctance machine. The unconventional approach allowed Applicants to overcome the "practically impossible" task of obtaining satisfactory performance while being cost competitive in the marketplace. There is no teaching or suggestion in any of the references that segmenting the stator would improve the electrical characteristics of the stator and provide more robust sensorless rotor position sensing.

Switched reluctance machines selectively energize one set of phase windings to produce output torque. A controller connected to the switched reluctance machine requires a rotor position signal to energize of the phase windings at the correct time. The rotor position signal can be generated using a rotor position transducer or using a sensorless approach. Because the cost of rotor position transducers generally places switched reluctance machines at a competitive disadvantage with respect to other types of machines, commercial applications have attempted to use the sensorless approach.

Segmenting the stator in a switched reluctance machine provides results that are unique to switched reluctance machines. Namely, segmenting the stator allows the windings to be positioned far more accurately, which improves the resistance and inductance characteristics of the stator teeth. **See specification Paragraph [0049].** As a result, sensorless operation can be employed more effectively, which lowers the cost of the switched reluctance machine. The improved manufacturing tolerances allow less costly drive circuits and/or more accurate control of the switched reluctance machine.

For the foregoing reasons, Applicants respectfully assert that claims 1, 11 and 21 are allowable. The remaining claims are either directly or indirectly dependent upon claims 1, 11 and 21 and are allowable for the reasons set forth above.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1211.

Respectfully submitted,

Dated: August 2, 2002

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ATTACHMENT FOR SPECIFICATION AMENDMENTS

The following is a marked up version of each replacement paragraph and/or section of the specification in which underlines indicates insertions and brackets indicate deletions.

Please replace Paragraph **[0054]** with the following paragraph:

[0054] As previously mentioned, the stator segment core 120 is defined by a plurality of stator plates 126 that are stacked together. The stator plates 126 are die cut from thin sheets of magnetically conductive material. During the die cutting operation, a first pair of slits 150 are cut into the outer rim section 120 and a second pair of slits 152 are cut into the pole section 130 and central portions between the slits are deformed. The slits 150 are transverse in alignment relative to the slits 152. The stator plates 126 that form the stator segment core 120 are stacked and press fit. <u>As can be seen in FIG. 7C, the central portions 153 of the stator plates 126 are deformed by the die punch operation. In the example in FIG. 7C, the central portion 153-1 and 153-2 are deformed. The central portion 153-1 of the stator plate 126-1 is deformed into and received between slits of the adjacent stator plate 126-2. As can be appreciated, additional stator plates include a deformed central portion 153 that is received by slits 150 or 152 of an adjacent stator plate 126.</u> This operation results in the stator plates 126 being releasably interconnected to define the stator segment core 120.

Please replace Paragraph **[0059]** with the following paragraph:

[0059] Terminals 170 and 172 are shown in FIGs. 8 and 10A to be mounted in slots 174 and 176 (FIG. 10C) formed in an end surface 178A of the first end cap 164A.

One end of the winding wire 124 is connected to the first terminal 170 while an opposite end of the winding wire 124 is connected to the second terminal 172. Insulating material 177 is shown to be positioned to cover winding wire 124 on both lateral sides of stator core 120. The insulating material 177 is also positioned (but not shown) between the stator segment core 120 and the winding wire 124 <u>as can be seen in FIG. 7A</u>.